

The impact of an additional year in high school on academic performance at university: Evidence from a policy experiment in Ghana

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Summary

Motivation: While education plays a fundamental role in economic development, the design of an appropriate educational structure, including duration of study at various levels, remains an issue of major policy debate in many low-income countries. In Ghana, the issue of the length of high school education is an issue of ongoing policy debate.

Purpose: This study estimates the effects of an additional year in senior high school (SHS) on academic performance at university level.

Methods and approach: Using data from the two largest public universities in Ghana, the article exploits a unique natural experimental variation in the years of secondary education created by policy changes in pre-university education in Ghana to estimate the impact of an additional year in SHS on a number of academic outcomes at university level.

Findings: We find that an additional year of SHS education has no impact on academic performance. We did not find any statistically significant difference in the likelihood of completing undergraduate studies in four years, or of graduating with a first-class degree, or the final grade point average (GPA) of students who attended SHS for four years versus their counterparts who attended SHS for only three years. However, our descriptive analyses show that an additional year in SHS improves chances of students from less-endowed SHS gaining admission to university, especially to health sciences programmes.

Policy implications: The nuanced nature of the results suggests the need to further interrogate the policy on SHS duration in Ghana. This may help ensure that the implementation of the policy does not end up making some segment of the student population worse off.

KEYWORDS

academic performance, education, Ghana, public universities, senior secondary

1 | INTRODUCTION

The role of education in economic development has received significant attention in the academic literature. At the macro level, several studies have demonstrated a strong positive correlation between economic growth and average educational attainment and the quality of education (Barro, 2013; Hanushek & Woessmann, 2012; Stengos & Aurangzeb, 2008; Tallman & Wang, 1994; Wolff, 2001), with stronger effects found in lower-income

countries (Breton, 2013; Psacharopoulos & Patrinos, 2004). At the micro level, a plethora of studies have demonstrated that education improves living standards by raising incomes, providing the necessary skills and workforce, improves health through better decision-making and increased earnings to purchase better health inputs, and leads to better civic culture (Björklund & Moffitt, 1987; Campbell, 2006; Carneiro et al., 2011; Duflo et al., 2015a; Foltz & Gajigo, 2012; Jensen & Lleras-Muney, 2012; Kuepié & Nordman, 2016). Recent empirical research in education has focused on how to get children into school and how to improve learning outcomes (Duflo et al., 2015a, 2015b).

Notwithstanding the fundamental role of education in promoting economic development, several challenges remain, especially with respect to the design of educational systems that appropriately respond to the evolving needs of society and consequently improve living standards and transform lives (Abekah-Nkrumah et al., 2019). In several low-income countries (LICs) and lower-middle income countries (LMICs), these challenges have formed the basis for intense public debate among researchers and policy-makers on essential aspects of educational systems, such as structure, curriculum, financing, and duration.

The situation in many LICs and LMICs is similar to that of Ghana, the setting of the current study. In a bid to design an appropriate educational structure for the country, the duration of senior high school (SHS) education in Ghana has changed three times in the last 30 years, with the last change taking place in 2009. As part of a process to improve performance in the educational system, the duration of SHS education was increased by one year from three years to four years in 2007, replacing the previous three-year system that had operated for 20 years. However, following a change in government in 2008, the four-year system, which had been in place for only one year, reverted to three years in 2010. These changes, from three years to four years and back to three years, resulted in two cohorts of students, one of which had three years and one with four years SHS education. More importantly, the reversal from four years to three years meant that the last batch of the four-year cohort and the first batch of the three-year cohort were taught by the same set of teachers in SHS, wrote the same final secondary-school completion exams (the West African Senior Secondary Certificate Examination—WASSCE) and entered university in the same year.

Understanding the impact of these changes on student performance and labour market outcomes is important to inform policy-makers' future reforms. More significantly, the cost implications of an additional year in SHS are huge, especially for African governments facing fiscal constraints. For instance, Ghana spent an average of USD 660 on each of the 750,706 students enrolled in SHS in 2014 (Africa Education Watch, 2021). This implies that keeping these students in school for an additional year, assuming no cost changes, would cost the country USD 495.5 million or 0.9% of the 2014 gross domestic product (Africa Education Watch, 2021). In addition to this, there may be other costs to parents (for example, the cost of school supplies for the additional year) and students (for example, lost earnings from the extra year in school instead of entering the labour market) that we do not have information to quantify.

This study uses data from the two largest public universities in Ghana—the University of Ghana (UG) and Kwame Nkrumah University of Science and Technology (KNUST)—and exploits the unique natural experimental variation in the years of SHS education created by these changes in the duration of senior high school to estimate the effect of an additional year of SHS education on academic performance at the tertiary level. For each of the two universities, we estimate the effect of an additional year in SHS education on the likelihood of completing undergraduate education in four years, graduating with first class honours, final grade point average (GPA) or cumulative weighted average (CWA) of students' raw score, and the number of times a student failed a course. Our analysis controls for a rich set of potential determinants of academic performance at university, including student characteristics, quality of SHS attended, and type of university programme on which they enrolled.

There are several studies on secondary school duration and post-secondary school outcomes such as schooling achievement and educational choices (Büttner & Thomsen, 2015), student performance (Aksoy & Link, 2000; Bellei, 2009; Skirbekk, 2006), university academic performance (Krashinsky, 2014; Morin, 2010), cognition (Ozier, 2018), and student performance and earnings (Pischke, 2007). However, these studies have mostly focused

on using data from high-income countries (HICs) (Canada, Chile, Germany, and Switzerland). In many of these studies, much of the evidence on the effect of secondary school education comes from additional instruction time within the same school day, changes in the duration (years) of schooling, and legislation on compulsory schooling. Whereas the findings of some of these studies suggest a strong positive correlation between the duration of secondary education and school achievement and earnings (Aksoy & Link, 2000; Bellei 2009; Büttner & Thomsen, 2015), others suggest either no or small effect of secondary school education duration on students' academic performance (Morin, 2010; Skirbekk, 2006).

However, there are very few studies of education duration and post-secondary school outcomes from LICs and LMICs. These studies have mostly focused on labour market outcomes. For example, Duflo et al. (2021) estimated the effect of offering a scholarship to attend SHS in Ghana and find that those who received these scholarships were more likely to report positive earnings and earned more. Oyelere (2010) used the implementation and withdrawal of free primary school education to estimate very low returns to schooling in Nigeria. Apart from the issue of context, most of the earlier studies examined changes in the educational system that affected only particular groups of students or parts of a country. The current study, however, relies on a change in the educational system that is of a national character. Thus, the general absence of evidence in the LIC and LMIC literature, especially on the effect of SHS duration on academic performance at the tertiary level, coupled with the fact that existing studies have relied on data that is not national in nature, makes the current study an important contribution in this area.

The rest of the article is structured as follows. Section 2 provides relevant institutional detail on Ghana's education system. Section 3 describes the data source and empirical strategy. Section 4 presents the findings. Section 5 presents a discussion of the findings, with Section 6 concluding.

2 | REFORMS IN GHANA'S EDUCATION SYSTEM

The education system in Ghana has witnessed several reforms since independence in 1957. Prior to 1987, the structure of Ghana's education system was based on six years of primary education, four years of middle school education, seven years of secondary school (five years of Ordinary-level and two years of Advanced-level) and three years of university education. However, in 1987 a major reform of the structure of Ghana's education was undertaken, which resulted in a change from the 6-4-7-3 structure to a 6-3-3-4 configuration (six years of primary education, three years of junior high school [JHS], three years of SHS and four years of university education). The 1987 reform—which reduced the overall duration of education in Ghana—was premised on the fact that the duration of pre-secondary education (10 years) was not only too long, but also resulted in a relatively higher age (minimum 26 years) for completing undergraduate degrees, especially for middle-school leavers and was therefore costly to the government (Addae-Mensah, 2000; McWilliam & Kwamena-Po, 1975; Yusuf & Ofori-Abebrese, 2017).

The 6-3-3-4 system was operated for 20 years (1987–2007), until it was changed in 2007 to a 6-3-4-4 system (six years of primary education, three years of JHS, four years of SHS and four years of university education) following agitation on the need to improve the general quality of education at all levels in Ghana and specifically the performance of SHS leavers.¹ Barely three years after implementing the 6-3-4-4 system, in 2009, the new government changed it to a 6-3-3-4 system (six years of primary education, three years of JHS, three years of SHS and four years of university education). As earlier indicated, the recent change resulted in two cohorts (the last batch of the four-year group and the first batch of three-year group) of students who were taught by the same set of teachers in SHS, wrote the same final SHS completion exams (WASSCE), and entered university the same year.

¹For example, according to WAEC Official files (WAEC, 2016) in 2007, 28.25% of 133,235 who sat for the WASSCE English language examination had credit pass (Grades A1 to C6), while for Core Mathematics and Integrated Science 25.45% of 133,134 and 24.03% of 132,943 respectively achieved a credit pass.

Thus, these changes in the periods spent in primary, JHS, SHS, and university, with no change in the curriculum, provides a possible exogenous change in the duration of SHS education that can be used to examine its effect on academic performance at university level.

3 | METHODOLOGY

3.1 | Data

The study relied primarily on the administrative records of students from the two largest public universities in Ghana—the University of Ghana (UG) and Kwame Nkrumah University of Science and Technology (KNUST). Our intention was to include all public universities and all private universities that had been in existence prior to the introduction of the four-year SHS in 2007. A critical inclusion criterion was that the university collected information on the date an applicant started SHS as part of information collected during admission. This is the crucial information for identifying whether a student belonged to the three-year group or the four-year group. Only the University of Ghana routinely collected such information, as part of their admission process. Even though KNUST did not routinely collect this information, the academic affairs directorate of KNUST agreed to work with the researchers to conduct a survey of all students in the affected cohort to collect the relevant information for identifying the two groups of students. The survey also collected additional socioeconomic background information on students that had not been routinely collected.

In both universities, we obtained de-identified information on demographic characteristics (age, gender, region of residence), high school information (high school attended, year of first attendance, year of completion, administrative region in which school is located, SHS completion aggregate, region of school), limited socioeconomic background information (parental occupation and pre-university employment) and student academic records (raw final score of all courses taken at the university, cumulative GPA at the end of each semester—or CWA in the case of KNUST—area of academic major, college of academic programme, and information on graduation status). Besides UG and KNUST, we also collected similar data from two other universities—the University of Development Studies (UDS) and the Central University College (CUC), a private university. We have not, however, been able to include the data from these two universities in our analysis due to the unavailability of key variables needed for the estimation.

3.2 | Empirical study

This study exploits the natural experiment created by the introduction and subsequent reversal of the four-year senior high school system to credibly identify the causal effect of the additional year in SHS on academic performance at the university level. Due to the nature of the introduction and subsequent withdrawal of the four-year duration, the last cohort affected by the four-year SHS (the 2009 entry cohort) and the first cohort of the three-year SHS after the reversal (the 2010 entry cohort) completed SHS at the same time. These two cohorts sat the same final SHS completion exams (the West African Senior Secondary Certificate Examination—WASSCE) and were eligible to enter university and other tertiary institutions at the same time. Once at university, as long as they are enrolled in the same programme, these students were exposed to the same academic environment and constraints, with the only difference being the duration of their senior secondary schooling. The study focuses on these two cohorts and compares their academic performance at the university level. We believe that this is a valid comparison because these two cohorts were exposed to the same academic environment. The thrust of our empirical strategy is to compare the academic performance of students exposed to the two durations of SHS and enrolled in the same programme at the university level as in [Equation 1](#) below.

$$perf_{ip} = \alpha + \theta_1 SSSdura_{ip} + \theta_2 WASSCE_{ip} + \theta_3 gender_{ip} + \theta_4 age_{ip} + \theta_5 Socio_{ip} + \theta_6 college_{ip} + \theta_7 rank_{ip} + \mu_p + \varepsilon_{ip} \quad (1)$$

Where subscripts i and p stand for student and programme of study. *SSSdura*, our main independent variable of interest is a dummy variable that takes a value 1 if the student had a four-year SHS and 0 if the student had the three-year SHS. *WASSCE* is the student's best aggregate score in the WASSCE, *gender* and *age* refer to the student's gender and age at enrolment at university. *Socio* is the socioeconomic background of the student which we proxy with the occupation of the student's parents. *rank* is the rank of the SHS the student attended, a measure of the quality of the SHS attended by the student. The ranks used were obtained from a publicly available classification used by the Computerized School Selection and Placement System (CSSPS) for the purposes of ranking the SHS. Under the CSSPS ranking, all private and public SHS in the country are ranked and classified under four categories (Best, Better, Good, and Other). μ_p is program-of-study fixed effects and ε_{ip} is the idiosyncratic error term. The parameter of interest is θ_1 and based on existing literature (Büttner & Thomsen, 2015; Krashinsky, 2014) we hypothesize that $\theta_1 > 0$, that is, we expect superior academic performance for the students who attended SHS for four years.

$perf_{ip}$ refer to the outcome variable. We consider five different outcome variables. These are: (1) an indicator for graduating within the prescribed four years needed to complete an undergraduate programme; (2) an indicator for graduating with a first-class result²; (3) average scores obtained at the university; (4) final GPA (CWA³ in the case of KNUST); (5) an indicator for failing a university course⁴; and (6) number of courses failed. We run separate regressions for the two universities and report robust standard errors. All estimates are based on ordinary least squares (OLS).

4 | RESULTS

4.1 | Descriptive statistics

Table 1 presents the descriptive information of the samples for the two universities. For each university, we compare descriptive information for the two groups of students. For KNUST, our sample is made up of 3265 students—1387 in the three-year group and 1869 in the four-year group. The UG sample is made up of 6056 students—2341 students in the three-year group and 3625 students in the four-year group. In KNUST, the gender composition of the students across the two groups is similar, but in UG, the gender composition is significantly different between the two groups. There are more males in the four-year group (54%) than in the three-year group (50%).

As expected, in both universities, the four-year group was exactly one year older than the three-year group at the time of enrolment at university. However, for each group, the average student at KNUST is around six months older than the average student at UG. Again, as expected, in both cases, the average student in the four-year group entered with a lower (better) SHS aggregate than the average student in the three-year group.⁵ In KNUST, the average aggregate for the four-year group was 14.83 compared to 15.52 for the three-year, while in UG, the average was 12.84 for the four-year group compared to 13.41 for the three-year group. This suggests that, on

⁵Because of the nature of the scoring, a lower SHS aggregate represents better performance in the exams.

²For University of Ghana, a first class is defined as *final GPA* ≥ 3.60 . For KNUST, a first class is defined as *final CWA* ≥ 70

³CWA stands for Cumulative Weighted Average. It is calculated as weighted average of raw scores with course credits as the weights.

⁴In both universities the pass mark is 50%.

TABLE 1 Descriptive statistics

	KNUST			UG		
	3 years	4 years	p-value	3 years	4 years	p-value
Number of students	1387	1869		2431	3625	
Male	41.67%	40.88%	0.649	50.4%	53.6%	0.015
Age (years) at enrolment	18.94	19.94	0.000	18.23	19.22	0.000
SSS aggregate	15.52	14.83	0.000	13.41	12.84	0.000
Parent occupation						
University staff/Other educ.	0.14%	0.05%		9.34%	9.96%	
Banking and Finance	0.50%	0.43%		10.41%	10.57%	
Public/Civil Service	27.25%	28.46%	0.589	23.24%	23.75%	0.338
Business executive	10.31%	9.31%		6.29%	5.81%	
Self-employed	42.25%	43.87%		30.60%	31.12%	
Other	19.54%	17.87%		20.12%	17.79%	
SSS ranking						
Other (Private & others)	12.33%	10.11%		3.37%	3.89%	
Good	10.67%	14.55%	0.001	3.17%	5.49%	0.000
Better	15.65%	17.87%		11.68%	14.59%	
Best	61.36%	57.46%		81.78%	76.03%	
College						
Basic & Applied Sciences	43.55%	40.02%		23.36%	18.69%	
Health Sciences	4.76%	5.56%	0.104	1.90%	2.52%	0.000
Humanities	51.69%	54.41%		65.90%	70.60%	
Education	-	-		8.84%	8.20%	
Final GPA/CWA	62.62%	62.75%	0.568	3.02	3.03	0.358
Graduated within 4 years	91.36%	91.52%	0.873	63.39%	65.88%	0.047
Graduated with first class	13.84%	12.89%	0.431	8.53%	8.82%	0.010
Ever failed a course	12.47%	12.73%	0.891	9.95%	8.47%	0.048
Number of times failed	8.40	7.76	0.040	3.04	2.68	0.003

Source: Computed by authors based on data from KNUST and UG.

average, students enrolling at UG have a lower (better) SHS completion exam aggregate compared to their contemporaries from KNUST.

The distribution of parents' education is quite different between the two universities. In KNUST, most students' parents are self-employed for public or civil servants. This is much less so in UG. Also, the proportion of students whose parents or guardian work for the university is substantially different. UG tends to admit far more students whose parents or guardian work for the university (9% of the three-year group and 10% of the four-year group) compared to KNUST (0.14% and 0.05%). Within each university, however, there is no difference in the distribution of parental education between the two groups of students.

In terms of the quality of SHS students who attended both universities, the distribution is heavily skewed in favour of the best senior high schools. In both universities, the majority of students came from the best SHS; 61.4% and 57.5% for the three-year and four-year cohorts respectively in the case of KNUST and 81.8% and 76% in the case of UG. In UG, less than 7% of the least endowed schools ("Good" and "Private") account for less than 7% for the three-year group and less than 10% for the four-year group. These percentages are much higher across the two groups in KNUST. It is instructive to note that in both universities there is a lower concentration of enrolled students in the better high schools in the four-year group compared with the three-year group. For example, for students from "Good" SHS, 10.7% of the three-year group compared to 14.6% of the four-year group enrolled in KNUST and 3.2% of the three-year group compared to 5.5% of the four-year group enrolled in UG. This is an indication that the four-year system might have been beneficial for the relatively weaker senior secondary schools (i.e. "good" and "better" SHS).

In terms of the colleges, in both universities, most of the students were in the Humanities and Social Studies faculties. However, a significantly higher proportion of students study basic and applied natural sciences in KNUST compared to UG. In KNUST, there is no significant difference in the chosen faculty between the three-year and four-year groups. In UG, however, there is a significantly high proportion of students in the four-year group in the humanities compared to the three-year group. Furthermore, a higher proportion of the students from the four-year group in both schools enrolled in the Health Sciences.

In terms of the outcome variables, [Table 1](#) shows slight performance advantage for the four-year group in both universities. Students from the four-year group are also slightly more likely to graduate within four years and more likely to graduate with first class honours, even though there is no significant difference in the final grade point average (GPA) or cumulative weighted average (CWA). The four-year group are also less likely to fail a course and did in fact fail fewer courses compared to the three-year group.

4.2 | Regression results

4.2.1 | University of Ghana (UG)

[Table 2](#) presents our main regression results for the University of Ghana. The outcome variables are an indicator for graduating within four years, indicator for graduating with a first class, final GPA, average marks obtained at the university and number of times the student failed a grade at the university.

[Table 2](#) shows that duration of SHS has no effect on the probability of graduating within four years, graduating with a first class, a higher final GPA, number of courses failed, and the average marks obtained at university. The coefficients for graduating within four years and a higher final GPA are positive. The results, however, suggest that there is no statistically significant difference between those who attended SHS for three years or four years. For the indicator for graduating with a first class, the coefficient has a negative sign, but it is statistically indistinguishable from zero.

In terms of the other coefficients, the strongest predictors of academic performance are gender, quality of SHS attended, SHS aggregate and college of study. Females outperformed males on all five outcome variables in [Table 2](#). Females are 14 percentage points more likely to graduate within four years, six percentage points more likely to graduate with a first class, and their final GPA was 0.15 percentage points higher than males. As expected, students from high-quality SHS perform better than those from relatively weak SHSs. Students who performed better in the final SHS completion examinations also performed better in all three outcome measures. Students from the non-natural science colleges performed better than those whose degrees were in the college of basic and applied sciences.

TABLE 2 Effect of duration of SHS on on-time graduation, graduation with first class, and final GPA (UG)

VARIABLES	(1)	(2)	(3)	(4)	(5)
	Indicator for graduated within 4 years	Indicator for graduated with first class	Final GPA	Total number of courses failed at the University	Average marks obtained at the University
Duration of SSS = 4 years	0.003 (0.014)	-0.008 (0.011)	0.017 (0.017)	-0.210 (0.172)	0.296 (0.246)
Student is male	-0.151*** (0.011)	-0.058*** (0.009)	-0.151*** (0.013)	1.273*** (0.121)	-3.097*** (0.185)
Age at start of programme: 18 years	-0.018 (0.024)	-0.008 (0.021)	-0.022 (0.030)	0.336 (0.251)	-0.462 (0.409)
Age at start of programme: 19 years	-0.012 (0.026)	-0.002 (0.022)	-0.054* (0.032)	0.379 (0.281)	-0.684 (0.441)
Age at start of programme: 20 years	-0.029 (0.029)	-0.006 (0.024)	-0.071** (0.036)	0.581* (0.312)	-1.107** (0.491)
Age at start of programme: 21+ years	-0.038 (0.039)	-0.006 (0.028)	-0.091** (0.044)	1.128*** (0.437)	-1.831*** (0.649)
Banking & Finance	-0.017 (0.024)	-0.025 (0.020)	-0.094*** (0.028)	0.412 (0.258)	-1.525*** (0.394)
Civil/Public Servant	-0.025 (0.021)	-0.011 (0.018)	-0.044* (0.024)	0.326 (0.223)	-1.034*** (0.343)

TABLE 2 (Continued)

VARIABLES	(1)	(2)	(3)	(4)	(5)
	Indicator for graduated within 4 years	Indicator for graduated with first class	Final GPA	Total number of courses failed at the University	Average marks obtained at the University
Business Executive	-0.046 (0.028)	-0.046* (0.021)	-0.095*** (0.032)	0.847*** (0.319)	-1.886*** (0.462)
Self-Employed	-0.033 (0.020)	-0.022 (0.017)	-0.055** (0.023)	0.407* (0.222)	-1.206*** (0.333)
Other	-0.063*** (0.022)	-0.019 (0.019)	-0.024 (0.025)	0.236 (0.232)	-0.908** (0.356)
SSS ranking is good	0.048 (0.043)	0.032 (0.028)	0.119** (0.050)	-1.200** (0.507)	1.906*** (0.712)
SSS ranking is better	0.102*** (0.036)	0.056** (0.023)	0.116*** (0.044)	-1.713*** (0.419)	2.694*** (0.591)
SSS ranking is best	0.098*** (0.034)	0.025 (0.020)	0.063 (0.041)	-1.472*** (0.392)	2.078*** (0.545)
SSS aggregate	-0.028*** (0.001)	-0.013*** (0.001)	-0.035*** (0.002)	0.355*** (0.017)	-0.772*** (0.024)
College: Health Sciences	0.184***	0.133***	0.385***	-4.062	3.318***
College: Humanities	(0.025)	(0.039)	(0.037)	(0.218)	(0.424)
College: Education	0.045*** (0.015)	0.032*** (0.010)	0.116*** (0.017)	-2.444*** (0.189)	2.542*** (0.243)
Constant	0.097*** (0.024)	0.042*** (0.016)	0.141*** (0.027)	-2.859*** (0.284)	3.317*** (0.400)
	1.135*** (0.050)	0.253*** (0.038)	3.448*** (0.060)	0.343 (0.581)	78.270*** (0.820)

(Continues)

TABLE 2 (Continued)

VARIABLES	(1)	(2)	(3)	(4)	(5)
	Indicator for graduated within 4 years	Indicator for graduated with first class	Final GPA	Total number of courses failed at the University	Average marks obtained at the University
Observations	5064	3886	3886	5064	5064
R-squared	0.117	0.049	0.153	0.177	0.251
F-statistic	38.47	10.47	42.86	51.82	43.12

Each column reports results from a separate regression. The omitted category for duration of SSS is 3 years. Omitted category for gender is female. Omitted category for age group is those aged 17 years or less. Omitted category for parent education is university staff. Omitted category of SSS ranking is other schools. Omitted category for college is college of basic and applied science. Regressions in columns (2) and (3) are restricted to only students who had graduated. Robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at 1%, 5%, and 10% respectively.

4.2.2 | Kwame Nkrumah University of Science and Technology (KNUST)

Table 3 presents the results for the effect of duration of SHS on academic performance for KNUST students. The outcome variables are an indicator variable for graduating within four years, an indicator for graduating with a first class, final cumulative weighted average marks (out of 100) and the number of times a student failed a course at university.

As with UG, we find that duration of SHS has no effect on any of the performance measures. The coefficients on the indicator for attending SHS for four years is negative in all cases even though none is statistically different from zero. The table shows that students who attended SHS for four years have a similar probability of failing a course and failed similar number of courses as those who attended SHS for three years. As in the case of the University of Ghana, the strongest predictors of academic performance are gender, quality of SHS attended, SHS aggregate, and college of study. Unlike UG, male students outperformed female students in KNUST. Surprisingly, students from the better-ranked SHSs performed worse. However, consistent from our findings from UG, students in the humanities performed better than students in natural sciences.

5 | DISCUSSION

The study set out to examine the benefits of one extra year of SHS education on academic performance at the university level using data from the two biggest public universities in Ghana. The study exploits variation in the level of SHS education resulting from a natural policy experiment to extend the duration of SHS education from three years to four years. These changes resulted in a particular cohort of SHS graduates which had two groups of students: one with three years of SHS and another with four years of SHS who sat the same SHS exit exams and entered university at the same time. We compared the academic performance of these two groups of students at the university level using different measures of academic performance. Our results show that the additional year in SHS had no impact on any of our measures of academic performance. The additional year in SHS did not influence the likelihood of graduating within four years, graduating with a first class, the final GPA or CWA, the number of times a student fails a course, or average marks obtained at university. Our results show that factors that affect academic performance at university include gender, quality of SHS attended, SHS final completion exam aggregate, and college of study. It is important to note that, while females outperformed males in UG, the reverse is the case in KNUST.

As indicated earlier, the evidence on returns to education at both the macro and micro levels is not conclusive. Mincer's theory of human capital suggests that marginal increases in school duration should lead to increases in students' performance (Mincer, 1974). Most importantly, there is substantial evidence in the micro literature to suggest that educational duration has a significant effect on the academic performance of students either in the same school or at the tertiary level (Aksoy & Link, 2000; Bellei, 2009; Büttner & Thomsen, 2013). This notwithstanding, other studies suggest either no or insignificant effect of educational duration on academic performance at the university level (Morin, 2010; Pischke, 2007; Skirbekk, 2006). Thus, the current finding is consistent with the existing literature, and strengthens the argument that the duration of SHS education alone may not be enough to drive a positive change in students' academic performance either at the same level or even at higher levels in the future. It is, for example, argued that pre-schooling heterogeneity in abilities may be a more important determinant of academic performance compared to length of time in school (Skirbekk, 2006). Again, the additional time available to students may not necessarily mean that students use such time efficiently to achieve positive outcomes. In schools where there are no relevant incentives for the efficient use of the extra time, outcomes may not change, or it may be that those with additional time do not gain any advantage (Skirbekk, 2006). Pischke (2007) also found in Germany that the effect of shortened school duration on human capital accumulation was short-lived, given that students were able to catch up quickly. In explaining his findings, he argues that returns

TABLE 3 Effect of duration of SHS on CWA, on-time graduation, and graduating with first class (KNUST)

VARIABLES	Indicator for Graduated within 4 years	Indicator for graduated with first class	Final CWA	Number of times failed a course at the University
Duration of SSS = 4 years	-0.013 (0.011)	-0.020 (0.014)	-0.259 (0.243)	-0.036 (0.326)
Student is male	0.057*** (0.010)	-0.016 (0.012)	0.519** (0.206)	-1.230*** (0.278)
Student was 18 years at start	0.023 (0.025)	0.009 (0.027)	-0.275 (0.503)	0.451 (0.677)
Student was 19 years at start	0.039 (0.026)	-0.003 (0.028)	-0.397 (0.523)	0.345 (0.708)
Student was 20 years at start	0.018 (0.028)	-0.008 (0.030)	-0.729 (0.557)	0.814 (0.750)
Student was 21 years or more at start	0.046* (0.026)	-0.002 (0.029)	-0.262 (0.540)	0.324 (0.709)
Banking & Finance	-0.007 (0.079)	0.167 (0.110)	1.588 (2.717)	-1.665 (3.277)
Civil/Public Servant	-0.026 (0.049)	0.146* (0.075)	2.101 (2.358)	-2.225 (2.635)
Business Executive	-0.043 (0.051)	0.122 (0.076)	0.869 (2.370)	-0.739 (2.661)
Self-Employed	-0.036 (0.049)	0.167** (0.075)	2.127 (2.352)	-1.993 (2.626)
Other	-0.006 (0.049)	0.158** (0.075)	2.030 (2.359)	-2.246 (2.639)
SSS ranking is good	-0.057*** (0.022)	-0.176*** (0.024)	-4.736*** (0.530)	5.388*** (0.710)
SSS ranking is better	-0.108*** (0.023)	-0.173*** (0.022)	-5.828*** (0.515)	7.207*** (0.739)
SSS ranking is best	-0.108*** (0.021)	-0.197*** (0.021)	-6.492*** (0.492)	7.458*** (0.688)
SSS aggregate	-0.011*** (0.001)	-0.025*** (0.001)	-0.789*** (0.025)	0.940*** (0.034)
College: Health Sciences	0.005 (0.020)	0.026 (0.032)	-0.272 (0.520)	-1.507** (0.612)
College: Humanities	0.027** (0.011)	0.028** (0.013)	1.341*** (0.227)	-2.842*** (0.321)
Constant	1.136***	0.530***	77.674***	-8.836***

TABLE 3 (Continued)

VARIABLES	Indicator for Graduated within 4 years (0.061)	Indicator for graduated with first class (0.085)	Final CWA (2.487)	Number of times failed a course at the University (2.822)
Observations	3242	3256	3242	3255
R-squared	0.040	0.105	0.253	0.213
F-statistic	6.42	19.39	62.51	51.85

Each column reports results from a separate regression. The omitted category for duration of SSS is 3-years. Omitted category for gender is female. Omitted category for age group is those aged 17 years or less. Omitted category for parent education is university staff. Omitted category of SSS ranking is other schools. Omitted category for college is college of basic and applied science. Robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at 1%, 5% and 10% respectively.

to additional year of schooling are not governed by a simple linear human capital model, where each hour of education has the same effect. The core of his argument is that just altering the length of schooling without making any serious change to the quality of the curriculum may end up having only short-term or no effect on human capital accumulation. It is, therefore, not surprising that a change in the duration of SHS education in Ghana without any alteration to the syllabus and quality of other inputs into the education process did not yield significant returns in terms of performance at the tertiary level.

It is also important to emphasize that the majority of students who enrolled in both UG (81.8% three-year and 76% four-year cohorts) and KNUST (61.4% three-year and 57.5% four-year cohorts) came from the best schools. This suggests that a large proportion of the sample from both UG and KNUST are students with a relatively strong academic background. More importantly, more of the three-year cohorts from the best schools enrolled at university compared to the four-year cohort. This suggest that the three-year cohort used in this sample may be made up of students who are relatively strong academically. Hence, a one-year reduction in the duration of SHS may not seriously place them at any form of disadvantage, which might explain the insignificant difference in university academic performance between the three-year and four-year cohorts.

Following from the above, a key question is whether the current results could be used as the basis to argue that the four-year duration was unnecessary, and that the three-year system should be the way forward. Indeed, a shortened duration of SHS education has several advantages to students, parents, and the state in the short term and long term. This may include reduced cost of education for the government, parents, and students, increased length of working life for the students and implications for pensions, implications of education duration on fertility, and consequently birth outcomes, especially for women who wish to attain higher educational qualification. For example, longer educational duration may mean that women, especially those who wish to attain higher educational qualification, may significantly delay the birth of their first child, with the attendant pregnancy complications and adverse birth outcomes (Hoffman et al., 2007; Utting & Bewley, 2011). These and other advantages make shortened educational duration a preferred policy option.

Notwithstanding the benefits of shortened education duration, the results of the current study are not clear-cut, and it would therefore be wrong to suggest that the current results are enough to confirm or validate the three-year duration of SHS in Ghana. First, this study is unable to account for potential fertility and other health benefits of an additional year of schooling for women, as widely documented in the literature (Currie & Moretti, 2003; McCrary & Royer, 2011). In a context like Ghana's, where cultural norms and family traditions exert significant pressure on women to marry and start having children from an early age, the adverse fertility effects of shorter duration of SHS cannot be overlooked. Second, the results suggest that more of the four-year cohorts from the less-endowed (better and good) schools enrolled at the tertiary level. This suggests that

for weaker schools, the four-year duration may be appropriate given that it enables more of them to enter the tertiary level. Third, for both UG and KNUST, students from the four-year cohort were more likely to enrol in the health sciences compared to the three-year cohort. This may be because the rigorous nature of health sciences requires more preparation than the other disciplines. Fourth, the descriptive statistics suggest that the four-year cohort in UG performed better on all but one of the performance indicators compared to their KNUST counterparts. This may mean that the effect of educational duration on human capital accumulation may also depend on the context in question. Finally, changes in education duration have implications for several other outcomes (labour market, fertility, etc.) apart from academic performance, which is the subject matter of this study. Thus, the results of the current study can hardly be used as the basis for determining the overall effect of the duration of SHS education in Ghana. There is a need for further interrogation of existing data, paying particular attention to soft issues that are less likely to be captured in quantitative data such as the one used in this study. Such analysis may provide a better explanation of the current results and, consequently, help with policy formulation and implementation.

Although the issue of duration seems to have gained traction in educational policy discourse in Ghana, the results of this study suggest other policy-relevant variables such as gender, quality of the SHS attended, and the discipline of undergraduate study are key to performance at university level. There is a large literature both in economics and psychology (Dayioğlu & Türüt-Aşık, 2007; Ghazvini & Khajehpour, 2011; Sheard, 2009) suggesting that females tend to perform better academically than their male counterparts at university level. This notwithstanding, female enrolment at the tertiary level has been low in many LICs and LMICs. In Ghana, female enrolment at the tertiary level has been low, as evidenced in a gender parity index (GPI) at the tertiary level of 0.72 in 2017.⁶ In the 2014/2015 academic year, for example, females constituted only 37% and 35% of admissions to public universities and polytechnics respectively (Ministry of Education, 2018). Thus, the stronger performance of females in all the university-level academic performance indicators relative to males is a positive sign that continuous emphasis on progressive affirmative action policies in the education sector in Ghana will yield better returns and improve female participation at tertiary level. The fact that attending the best SHS confers an advantage in university-level academic performance is not surprising. In Ghana the best-ranked SHSs are mostly in urban areas, have better infrastructure, tutors, and a rich history of having produced some of the most influential actors in both the public and private sectors. Thus, students in such schools are more likely to have access to better resources and the foundation for current and future academic performance. Additionally, the fact that students in the humanities tend to perform better than their counterparts in the natural sciences suggests a need to focus a lot more attention on the development and resourcing of the scientific disciplines. Over the last couple of years, several policies, such as the STEM (science, technology, engineering and mathematics) programmes—the Ghana Partnership for Education Grant, the Ghana Skills and Technology Development Project, among others—have been implemented and aimed at improving academic performance in science education at both secondary and tertiary levels. However, the continued existence of wide variations in academic performance between the humanities and the sciences, as evidenced by the current results, suggests a need to intensify policy and implementable actions to bridge the gap.

6 | CONCLUSION

In conclusion, we argue that the conversion from a four-year to a three-year SHS did not adversely affect human capital accumulation at the tertiary level significantly. Thus, considering the possible advantages of a shortened duration of education, one might suggest that it would be advisable to maintain the three-year duration. This notwithstanding,

⁶The World Bank's World Development Indicators database shows that Ghana's GPI for tertiary enrolment in 2017 was 0.72 (World Development Indicators, n.d.).

the not wholly clear-cut nature of the results suggests that it may equally be appropriate to maintain the four-year duration in areas where the extended duration appears to benefit students more—for example, those entering into more rigorous disciplines, such as the health sciences, or coming from less-endowed schools. However, we acknowledge that such a differentiation of the duration of SHS would pose some challenges. In particular, it would present co-ordination problems at the system level and the transition to higher education. For instance, what criteria will be used to split the existing SHSs into three-year and four-year, as well as the criteria for selection of students into the two durations from the JHS level. Thoughtful solutions to these potential challenges should be found before a non-standard duration of SHS could be implemented.

More generally, our study has implications for ongoing discussion on the level of education that requires an additional level of investment. The Millennium Development Goals (MDGs) and their successors, the Sustainable Development Goals (SDGs), strongly emphasize primary education as opposed to secondary and tertiary levels. For countries like Ghana, which has achieved 100% gross primary enrolment for almost two decades, it is legitimate to ask whether it is now time to invest more in secondary and tertiary education. Indeed, it is likely that the current “free” secondary education in Ghana reflects this. However, any such focus shift should be balanced by the need to ensure quality at the primary level as well as ensuring that secondary and tertiary graduates acquire the necessary 21st-century skills to enable them to become entrepreneurs and job creators rather than merely job seekers. This latter consideration is important in the light of rapidly growing graduate joblessness in many African countries.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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